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INT CL[5] **G01B**
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(54) Monitoring fluid dispensing nozzle

(57) The operation of a nozzle 2 for dispensing drops of adhesive onto a circuit board is optically monitored. An LED source 12 illuminates the nozzle 2 through a lens 14. A droplet 10 on the nozzle casts a shadow on a photodiode detector 8. An output voltage from the detector 8 is measured before and after droplet formation, and again after the droplet has been released. The measured voltages are compared with standard values to determine whether the droplet is of an acceptable size. The optical system may include reflecting prisms, or a TV camera coupled to a pattern recognition system.

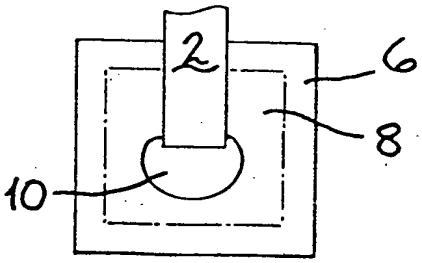

FIG.2

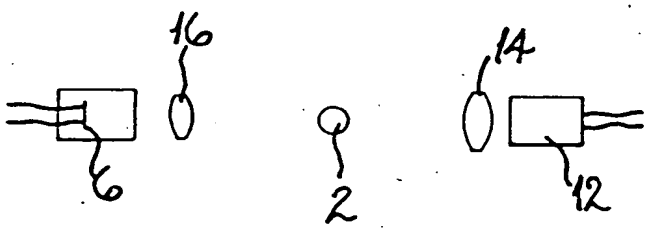

FIG.3

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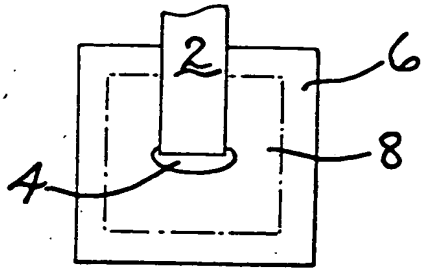

FIG. 1

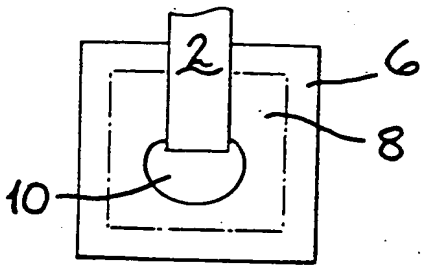

FIG.2

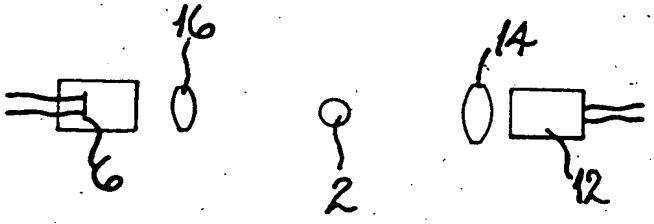

FIG.3

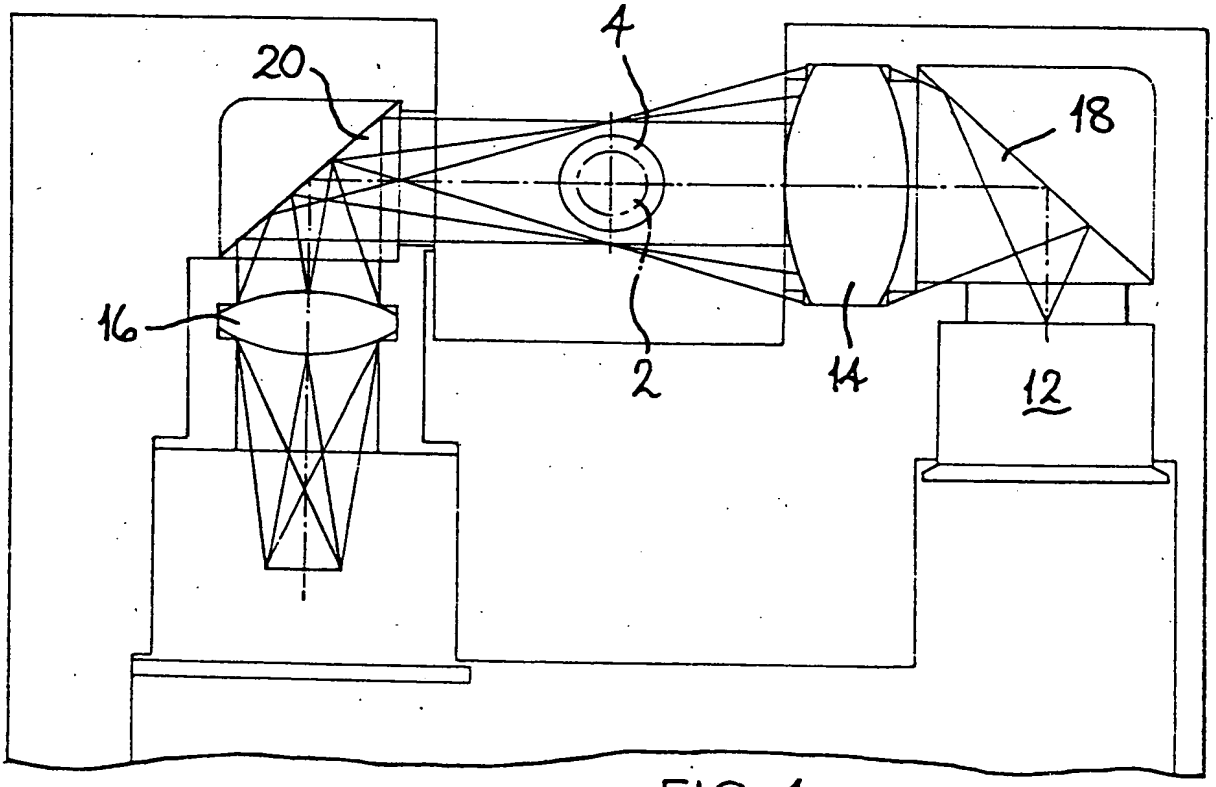

FIG.4

MONITORING SYSTEM

The present invention relates to an improved system for monitoring the operation of a dispensing nozzle for dispensing fluids. The system is particularly suitable for monitoring the dispensing of an adhesive, for example an epoxy or acrylic adhesive, from a nozzle, onto the surface of an object, for example a circuit board, that is moved between selected locations.

Known dispensing systems control the amount of fluid dispensed by the nozzle by controlling the time during which a syringe attached to the nozzle is dispensing fluid. This method has the disadvantage that any variation in the amount of fluid dispensed in the pre-set time is not detected until, for example, circuit boards are rejected at a later stage in the manufacturing process, because the amount of variation has become unacceptable. Variations in the amount of adhesive dispensed in the pre-set time can arise for a number of reasons. These reasons include changes in viscocity as the temperature rises or falls, or as the adhesive ages, and changes in pressure due to changes in the amount of adhesive actually in the syringe. The reject boards then have either to be scrapped, or the components mounted on them have to be salvaged, both of which are expensive and wasteful of valuable materials and labour. It has been proposed in European Patent Application No. 314,012 to monitor the dispensing of adhesive by inspecting the droplets of adhesive after they have been dispensed onto the circuit board. This has the disadvantage that if, for example, too much adhesive has been dispensed, it has already been deposited on the board, and corrective action must be taken.

It is an object of the present invention to provide an improved system for monitoring the operation of a dispensing nozzle for dispensing fluids, in which the above disadvantages are reduced or substantially obviated.

The invention provides a system for monitoring the operation of a dispensing nozzle for dispensing a fluid onto a surface, in which the amount of fluid dispensed is controlled by operating the nozzle for a pre-set time, characterised in that the system comprises

(a) means for inspecting the nozzle before the formation of a droplet of the fluid on the nozzle, after the formation of this droplet and before it is discharged and after the droplet has been discharged, in order to determine the amount of fluid present in the droplet and, optionally, other properties of the droplet, and

(b) means for comparing the amount of fluid and, optionally, other properties of the droplet, with standard values for these properties.

The inspection of the nozzle is preferably carried out optically.

The optical inspection means preferably comprises a photo-sensitive diode on which a focussed image of the nozzle is created.

The optical inspection means may alternatively comprise a television camera linked up to a pattern recognition system. This arrangement has the advantage that it is able to give more detailed information as to the shape of the droplet, but has the disadvantage that it is more expensive than the diode system, and takes up more space.

The invention further comprises a method of monitoring the operation of a nozzle for dispensing a fluid, characterised in that the nozzle is inspected before a droplet of the fluid is formed, it is inspected after a droplet is formed and before it is discharged, and it is inspected again after droplet discharge, and the results of these inspections are compared with standard results.

A preferred embodiment of a system according to the invention will now be described with reference to the accompanying drawings, in which

Figure 1 is a view of the nozzle before droplet formation;

Figure 2 is a view of the nozzle after droplet formation;

Figure 3 is a schematic diagram of an embodiment of a monitoring system; and

Figure 4 is a view from above of an embodiment of a monitoring system.

As can be seen in Figures 1 and 2, a nozzle (2) is mounted on a syringe (not shown) containing adhesive to be dispensed. There is a residue (4) of adhesive from the previous droplet retained on the end of the nozzle (2). The nozzle (2) is arranged in front of a white surface (6), an inner area (8) of which comprises a photo-sensitive diode having a square area which is uniformly sensitive to light. The shape of a droplet (10) formed on the nozzle (2) can be seen in Figure 2.

As is shown schematically in Figure 3, a light emitting diode (12) is used as the light source. A lens (14) is provided to focus the light from the diode which then illuminates the nozzle (2). A second lens (16) is provided to focus the image of the nozzle (2) on to the light-sensitive area (8) of the photo diode.

The schematic system shown in Figure 3 would be too long for incorporation in, for example, a component placement system. Therefore, as shown in Figure 4 silvered prisms (18, 20) are provided to rotate the beams of light through 90° in order to provide a more compact arrangement.

The operation of the system will now be described with particular reference to the dispensing of an adhesive onto a circuit board.

In operation, the nozzle is inspected prior to the formation of a droplet, i.e. in the state shown in Figure 1, and the output voltage (V_1) of the photo-sensitive diode (8) is measured and recorded. This output voltage is proportional to the amount of light falling on the diode,

which is itself related to the amount of adhesive on the nozzle. A droplet (10) is then allowed to form on the nozzle (2), and the output voltage (V_2) is again measured and recorded.

Comparison of the output voltages V_1 and V_2 is used to determine the amount of change in the dark area of the photo-sensitive diode, and hence the amount of fluid in the droplet. This change in output voltage is compared against the allowable range of changes in output voltage, to determine whether the amount of adhesive on the nozzle falls within acceptable limits. If it does, the nozzle is allowed to discharge the droplet in the correct position on the circuit board; if not, then the board is moved so that the droplet can be deposited in its "scrap area", and the droplet formation cycle is started again.

In addition to the monitoring of individual droplets in order to decide whether a particular droplet of adhesive falls within an acceptable range of tolerances, the monitoring system can also be used to monitor trends in the amount of adhesive dispensed by the nozzle over a number of successive operations. By monitoring such trends longer term effects such as changes in viscosity or dispensing characteristics as the syringe empties can be identified and the dispensing time can be controlled to bring the dot size into acceptable tolerances.

After the nozzle has discharged its droplet, the output voltage (V_3) of the photo-sensitive diode can again be measured and compared with the initial output voltage (V_1) to determine whether all of the adhesive has been discharged onto the circuit board.

CLAIMS:

1. A system for monitoring the operation of a dispensing nozzle for dispensing a fluid onto a surface, in which the amount of fluid dispensed is controlled by operating the nozzle for a pre-set time, characterised in that the system comprises

(a) means for inspecting the nozzle before the formation of a droplet of the fluid on the nozzle, after the formation of this droplet and before it is discharged and after the droplet has been discharged, in order to determine the amount of fluid present in the droplet and, optionally, other properties of the droplet and

(b) means for comparing the amount of fluid and, optionally, other properties of the droplet, with standard values for these properties.

2. A system according to claim 1, characterised in that the means for inspecting the nozzle comprises optical means.

3. A system according to claim 2, characterised in that the optical inspection means comprises a photo-sensitive diode on which a focussed image of the nozzle is created.

4. A system according to claim 2, characterised in that the optical inspection means comprises a television camera.

5. A method of monitoring the operation of a nozzle for dispensing a fluid, characterised in that the nozzle is inspected before a droplet of the fluid is formed, it is inspected after a droplet is formed and before it is discharged, and it is inspected again after droplet discharge, and the results of these inspections are compared with standard results.

6. A monitoring system substantially as herein described, with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

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Relevant Technical fields

(i) UK Cl (Edition K)

G1A (AAJ, AEB, AEF)
G1N (NCVD, NCVT, NCVX)

(ii) Int Cl (Edition 5) G01B

Search Examiner

D C BRUNT

Databases (see over)

(i) UK Patent Office

(ii)

ONLINE DATABASES: WPI

Date of Search

12 DECEMBER 1991

Documents considered relevant following a search in respect of claims

1-6

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	WO 90/01141 A1 (BIRKLE) SEE FIGURE 1	
A	US 4936828 A (CHIANG) SEE FIGURE 1	

SF2(p)

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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